



MONTHLY NOTICES

OF THE

ROYAL ASTRONOMICAL SOCIETY.

VOL. XLI.

MAY 13, 1881.

No. 7.

J. R. HIND, Esq., President, in the Chair.

John Alfred Barringer, Esq., Ackworth School, near Pontefract, Yorkshire;

Thomas Percy Gray, Esq., The Lodge, Clapham Road, Bedford; and

Robert Wigglesworth, Esq., St. Michael's House, Minster Yard, York,

were balloted for and duly elected Fellows of the Society.

On the Inclination of the Zodiacal Light. By T.W. Backhouse, Esq.

I do not know whether the inclination of the Zodiacal Light to the ecliptic has been calculated before, but even if it has, an independent investigation will not be without its value.

With this view, I have examined my observations of the position of the central line or axis of the Zodiacal Light from 1867 to the summer of 1877. There are altogether 418 observations of various points of the central line (counting those most roughly observed as but half an observation): $360\frac{1}{2}$ give northern latitude, average $+2^{\circ}32'$; $33\frac{1}{2}$ give the latitude as 0° ; and 24 give southern latitude, average $-0^{\circ}94'$. The average of the whole is $+1^{\circ}95'$; and the average deviation from the ecliptic is $2^{\circ}06'$.

I have arranged the observations according to their distance from the Sun, and according to the Sun's longitude. A summary of them is given in the accompanying table, which shows, in degrees, the average latitude of the axis for every 30° of the Sun's longitude, and every 30° of distance following the Sun. The number of observations is given below to the left of each average.

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TABLE I.
Longitude of Zodiacal Light following the Sun.

Sun's Long.	330° 345-316	300° 315-286	270° 285-256	240° 255-226	210° 225-196	180° 195-166	150° 165-136	120° 135-106	90° 105-76	60° 75-46	30° 45-16	Aver. and Total.
146-175			+2.0	-0.0	-1.2	-1.0						
176-205			1	4	4	1						
					+1.8	+0.4	+0.4					
206-235			3	22	27	10						
					+3.0	+2.0	-0.1	+0.0				
236-265			4	1	8½	7						
					+1.5	+2.5	+1.0	+1.3	+2.8	+2.0		
266-295			4	4	3	7½		9	8½	1		
					+1.5	+1.7	+2.2	+2.2	+1.9	+2.7		
296-325			2	1		2		8½	12½	2½		
					+1.3	+1.6	+1.5	+2.8	+2.2	+1.9	+2.4	
326-355				3	5	1		5	23½	19½	3½	
					+2.9	+1.9	+2.1	+1.7	+2.6	+2.4	+2.0	
356-25			1	5½	20½	11½		3	13½	35½	7½	
					+3.0	+2.2	+2.6	+1.4	+1.5	+2.5	+2.6	
26-55				1	11½	10½		7	1	10½	5½	
					+3.0	+3.6	+2.8	+2.4				
Average	+2.9	+2.5	+2.4	+1.1	+1.7	+1.4	+1.6	+1.9	+2.3	+2.3	+2.3	+1.59
Total	9	29	14	9	37½	78½	54½	37½	63½	69	16½	418

On the theory that the Zodiacal Light is a solar appendage, of lenticular form, decreasing in brightness from the Sun; that its central plane maintains a constant position; and that the counter-glow is not a physical feature, but an apparent phenomenon, causing an increase of brightness at the point opposite the Sun—this table should present greater regularity than it does: only that, as the Zodiacal Light is so very indefinite, and observations of its central line therefore so inexact, we should expect the errors of observation to be proportionately very great. On this account, it is necessarily difficult to arrive at a correct idea of the inclination. First, I endeavoured to find the longitude of the ascending node, in the following different ways:—

A general examination of the table here given, ignoring those cases where the number of observations is small, seems to indicate that its most probable position is at long. 30° .

If the assumptions given above are correct, twice in the year the Earth must be in the axis of the Zodiacal Light; and at these times the latitude will be 0° at and opposite the Sun, and will reach its maximum, *plus* and *minus*, 90° off it. Careful examination of several tables shows that this is the case at no time of the year; the average position of the Sun agreeing best with this is long. 232° , giving the ascending node at long. 52° .

Using only those few observations that seemed likely to be the best on account of their great altitude, and confining my attention to those few of these that were about 90° off the Sun, on account of their possessing a fair brightness, the most probable longitude of the ascending node comes out at 55° .

On the hypothesis of the counter-glow with which I began, the central line there will be nearer the ecliptic than the true position of greatest density of the Zodiacal Light; how much nearer, will depend on the relative rates of concentration of the Zodiacal Light itself, and of the law determining the counter-glow. From the best observations of the counter-glow, the ascending node is at 37° .

The average of all these results is 43° .

But probably the best mode of examining the observations is to see whether the latitude of each point in the central line rises and falls among the stars in the course of the year, as it should do if the theories with which I started are correct. By this means any false results which might arise from constant errors, such as might be caused by the brightness of neighbouring stars or the presence of unsuspected branches of the Milky Way, will be got rid of. For this purpose, a table has been prepared, showing the way in which the central line should rise and fall according to theory; and I have compared the observed latitude of each point of the central line with this theoretical table, to see with what longitude, with reference to the ascending node, it would agree best. The results are shown in Table II., the first column of which gives the average longitude of the portion of the Zodiacal Light examined, and the second column the longitude, with refer-

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ence to the ascending node, with which its variations agree best. The third column gives the longitude of the ascending node resulting from this.

TABLE II.

Long. of Zodiacal Light: Average Position Observed.	Agrees best with Ω +	Ascending Node.
340°	312°	28°
350	About 35	About -45
355	-15	10
11	-14	25
16	About 0	About 16
25	345	40
35	25 to 75	10 to -40
44	22, rather badly.	22
50	70, variations slight.	-20
62	30	32
111	67	44
126	About 100, variations slight.	About 26
147	100	47
164	90, very badly.	74
178	135, rather badly.	43
188	145	43
200	150, rather badly.	50
215	About 180, badly.	About 35
		Average 27

The best average of this table is 27°, which, combined with the average of the previous modes of examination, gives

Long. ascending node = 35°.

These results seem sufficiently consistent to give considerable probability, though I think not amounting to proof, that the hypotheses on which we started are in the main correct, and that the ascending node of the Zodiacal Light is somewhere about long. 35°.

The inclination is more difficult to determine. Theoretically, it would be very simply determined from the observations of the Zodiacal Light at the time when the Sun's longitude is 35° or 215°; but these are so irregular that it is impossible to ascertain it exactly. These observations are best satisfied by

Inclination = 1°7;

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but this requires the hypothesis of a constant error in all the observations, amounting to $+1^{\circ}.3$. Without any such hypothesis, the inclination comes out $2^{\circ}.9$, but in this case the probable error of the observations is much larger. It is obvious that either result is entitled to very little weight, the probable error in any case being very large.

If the Zodiacal Light is a solar appendage, we should not be surprised at finding its axis in the plane of the solar equator; but it is quite evident that such is not the case. We should have no reason for expecting it to be in the plane of the ecliptic rather than in that of any other planet's orbit; it would be more likely to be in the plane of the average position of the orbits of all the planets. But I have not calculated what this plane is, so as to avoid every bias in my investigations as far as possible.

Except on two nights, all the observations were made at Sunderland, lat. 55° N.

I have been aided in the calculations by J. Taylor, E. Dodshon, A. Gröne, and A. J. Edmunds.

Sunderland:
1881, April 27.

Note on the Flexure of the Greenwich Transit Circle.

By W. H. M. Christie, Esq.

Prof. Newcomb has recently called my attention to the practical difficulties attending the determination of the astronomical flexure by means of opposing collimators, and to the effect which the increase in the temperature of the air from the bottom to the top of the observing room might have on this observation. And he points out that if no change had been made in the adopted flexure at the time of the piercing of the cube of the Transit Circle, there would have been no striking change in the R—D correction. In his work on the "Declinations of Fixed Stars," pp. 35 and 36, Mr. Lewis Boss has examined the flexure and R—D corrections 1851–1872 with reference to Prof. Newcomb's suggestion, and has found that if the uniform flexure $+0''.21$ had been employed throughout the series, we should have had sufficiently good agreement between direct and reflection observations. This view entirely agrees with the conclusion at which I arrived in my paper on the Systematic Errors of the Greenwich N.P.D.'s from the discussion of the observations of circumpolar stars and of the Sun, before I was aware of Prof. Newcomb's suggestion or of Mr. Boss's work.

As further data are now available, I have thought it might be not without interest to compare the flexure and R—D corrections for the period 1851 to 1880. The following table is derived from that which I gave in the Addendum to my paper